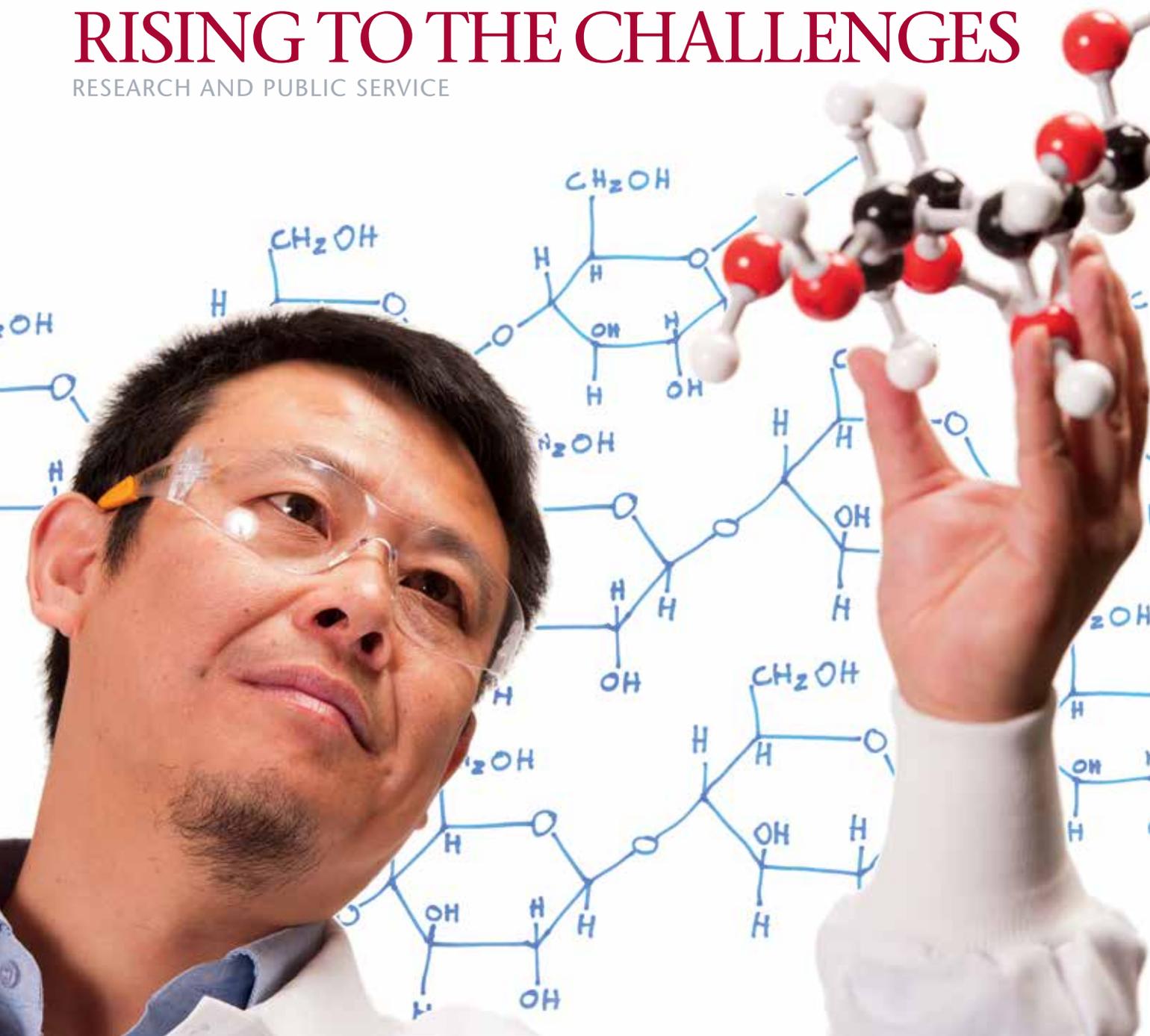
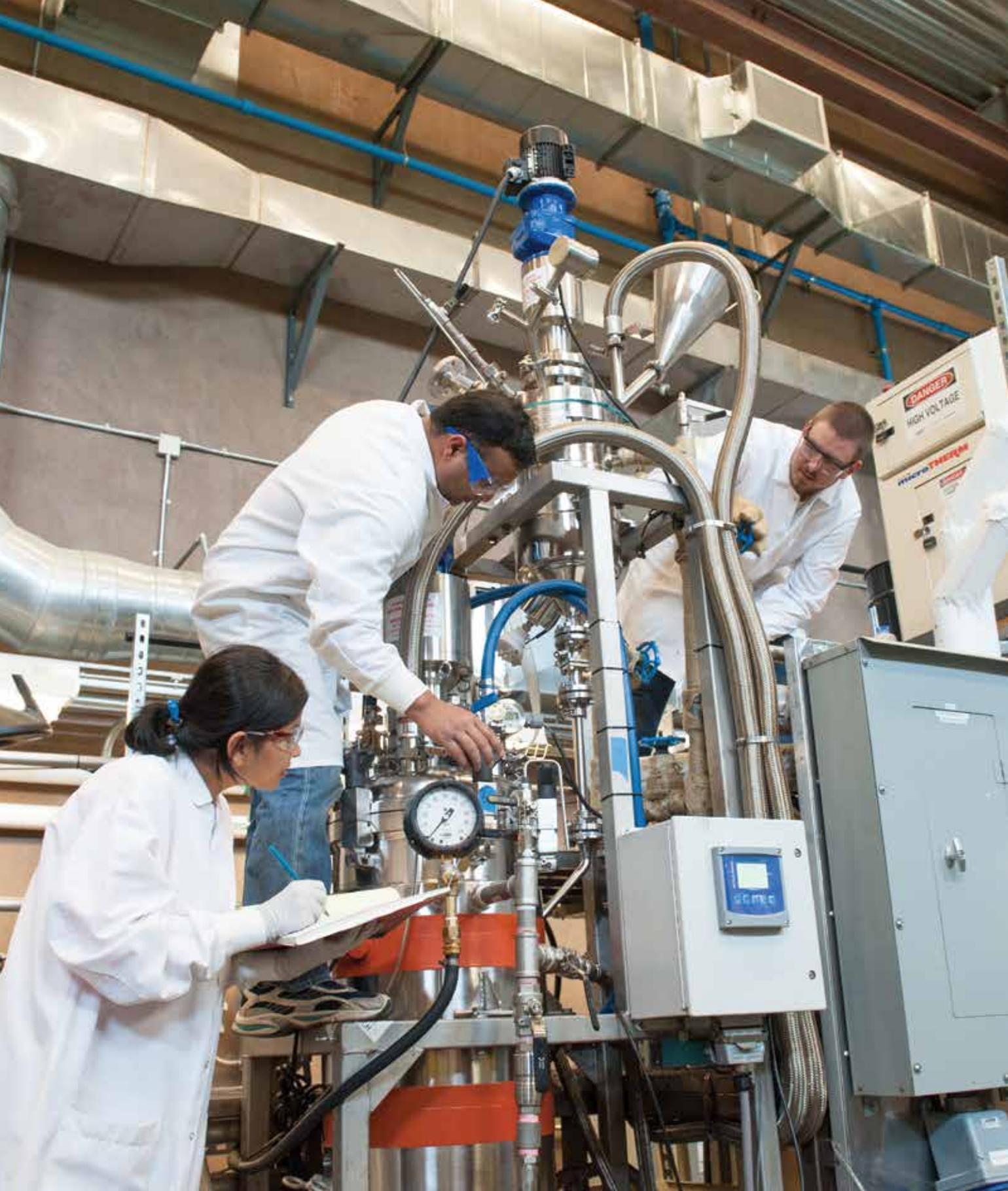


RISING TO THE CHALLENGES

RESEARCH AND PUBLIC SERVICE





RESEARCH AND PUBLIC SERVICE AT WASHINGTON STATE UNIVERSITY

RISING TO THE CHALLENGES

...

Washington State University is a tier 1 research institution and a nationally recognized land-grant university with a proud, 125-year tradition of research, discovery, teaching, and public engagement. The University's research agenda lays the groundwork for tangible solutions to complex societal concerns.

WSU researchers are focused on creating a healthier world and healthier people through a secure and abundant food supply, environmental and economic sustainability, cleaner technology, and new insights into human nature and behavior.

The research profiles here only hint at the greater volume of work conducted by each individual represented and by the University's many researchers whose names do not appear in this booklet.

To learn more about the University's worldwide landscape of research, visit research.wsu.edu.

...

AS THE NEW VICE PRESIDENT FOR RESEARCH at Washington State University, I'm pleased to share with you the breadth and excitement of the work we are doing here. We have strong research activities in the life and physical sciences; a range of research efforts to achieve environmental and economic stability, improved quality of life through engineering and smart applications of technology, and new solutions for food security; and numerous strengths in education and the arts.

In my previous roles at the U.S. Department of Energy and Lawrence Livermore National Laboratory, I regularly heard about the exemplary work going on at WSU. After joining WSU in July 2014, I'm even more impressed. As you will see in the following pages, we're pioneering new techniques to see how a deadly virus breaks through a cell's defenses; exploring fundamental properties of matter at extreme conditions, developing bio-based alternatives to the fossil fuel in asphalt binder, exploring ways to protect some crop species without adding pesticides, and developing a smart national power grid.

With strong support from government, industry, partners, and alumni, WSU's total annual research and development expenditures are now approaching \$350 million. We're ranked 68th in the nation in research and development expenditures by the National Science Foundation and are earnestly working to improve on that.

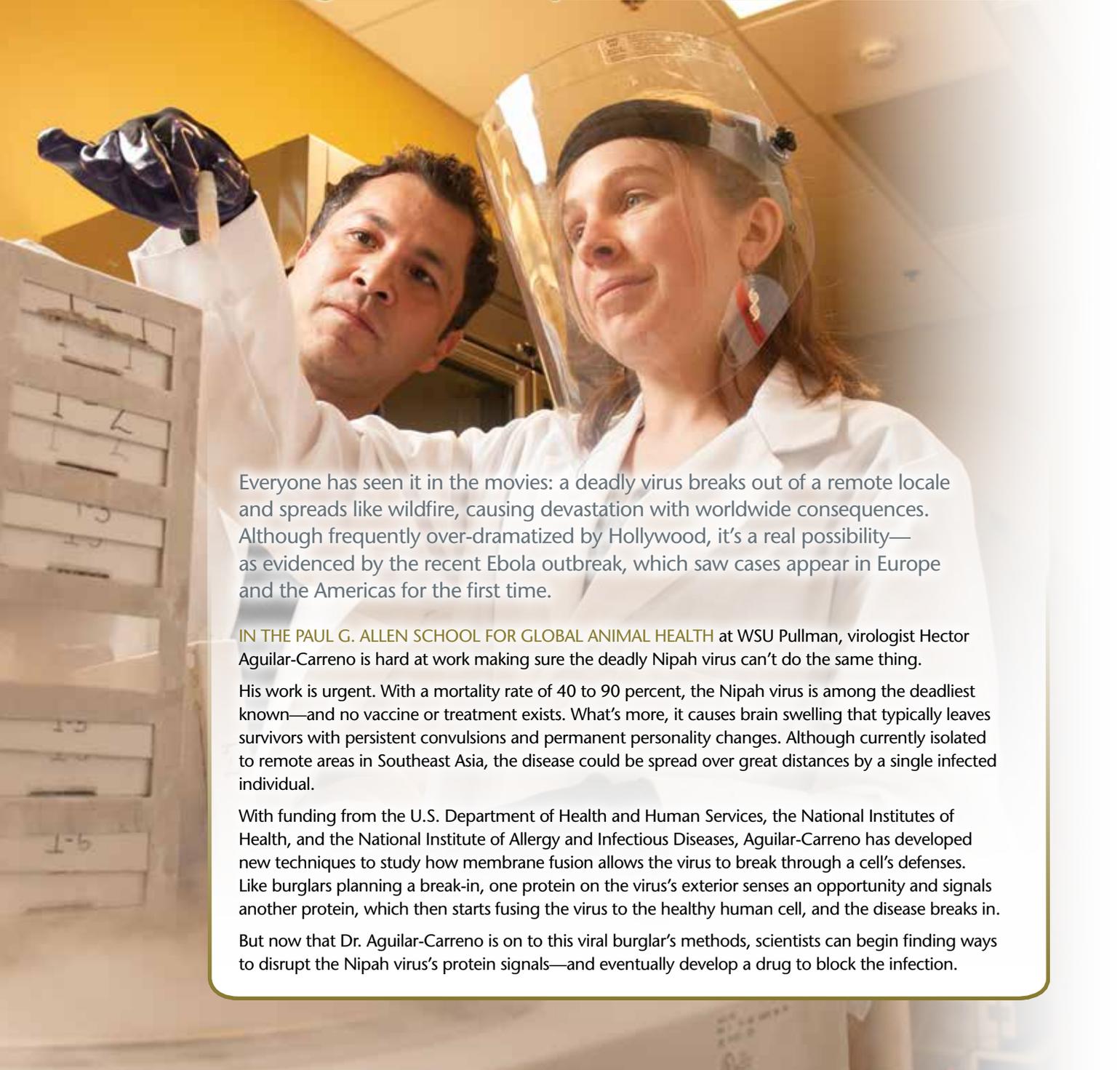
I'd like to thank Nancy Magnuson for her leadership and service as interim vice president for research. She handed off the Office of Research in excellent form, smoothing the transition to its next exciting chapter.

To that end, we have just completed a thorough strategic plan for the research enterprise, including the development of several interdisciplinary Grand Challenges to address problems of broad state, national, and international concern. The effort is in keeping with our land-grant mission and is uniting the WSU research community, changing the paradigm of the research enterprise, and serving to define, focus, communicate, and advocate the research agenda.

I look forward to reporting back to you on the progress of this effort next year.

Christopher Keane, Ph.D.
Vice President for Research

Disarming a Deadly Virus



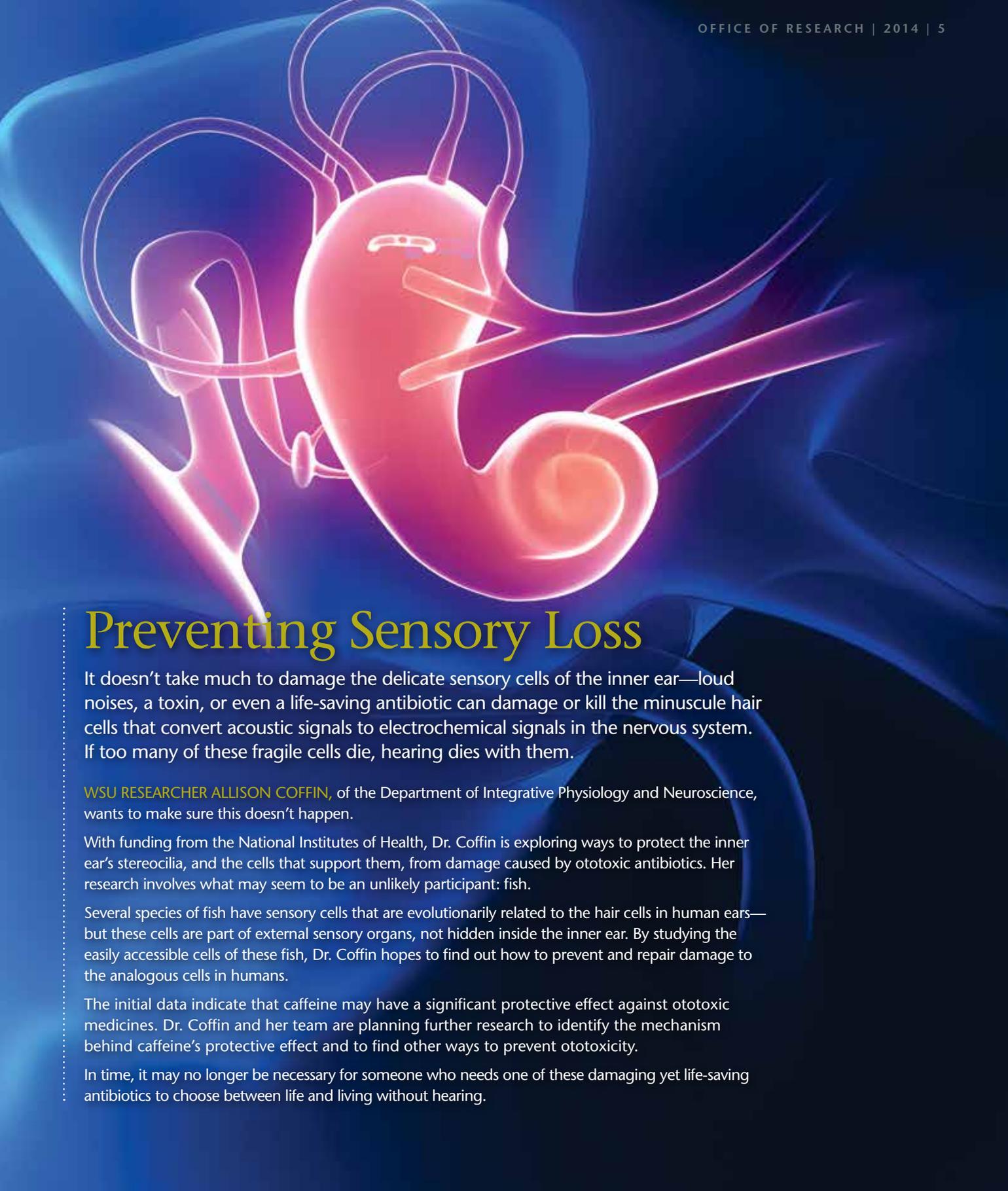
Everyone has seen it in the movies: a deadly virus breaks out of a remote locale and spreads like wildfire, causing devastation with worldwide consequences. Although frequently over-dramatized by Hollywood, it's a real possibility—as evidenced by the recent Ebola outbreak, which saw cases appear in Europe and the Americas for the first time.

IN THE PAUL G. ALLEN SCHOOL FOR GLOBAL ANIMAL HEALTH at WSU Pullman, virologist Hector Aguilar-Carreno is hard at work making sure the deadly Nipah virus can't do the same thing.

His work is urgent. With a mortality rate of 40 to 90 percent, the Nipah virus is among the deadliest known—and no vaccine or treatment exists. What's more, it causes brain swelling that typically leaves survivors with persistent convulsions and permanent personality changes. Although currently isolated to remote areas in Southeast Asia, the disease could be spread over great distances by a single infected individual.

With funding from the U.S. Department of Health and Human Services, the National Institutes of Health, and the National Institute of Allergy and Infectious Diseases, Aguilar-Carreno has developed new techniques to study how membrane fusion allows the virus to break through a cell's defenses. Like burglars planning a break-in, one protein on the virus's exterior senses an opportunity and signals another protein, which then starts fusing the virus to the healthy human cell, and the disease breaks in.

But now that Dr. Aguilar-Carreno is on to this viral burglar's methods, scientists can begin finding ways to disrupt the Nipah virus's protein signals—and eventually develop a drug to block the infection.



Preventing Sensory Loss

It doesn't take much to damage the delicate sensory cells of the inner ear—loud noises, a toxin, or even a life-saving antibiotic can damage or kill the minuscule hair cells that convert acoustic signals to electrochemical signals in the nervous system. If too many of these fragile cells die, hearing dies with them.

WSU RESEARCHER ALLISON COFFIN, of the Department of Integrative Physiology and Neuroscience, wants to make sure this doesn't happen.

With funding from the National Institutes of Health, Dr. Coffin is exploring ways to protect the inner ear's stereocilia, and the cells that support them, from damage caused by ototoxic antibiotics. Her research involves what may seem to be an unlikely participant: fish.

Several species of fish have sensory cells that are evolutionarily related to the hair cells in human ears—but these cells are part of external sensory organs, not hidden inside the inner ear. By studying the easily accessible cells of these fish, Dr. Coffin hopes to find out how to prevent and repair damage to the analogous cells in humans.

The initial data indicate that caffeine may have a significant protective effect against ototoxic medicines. Dr. Coffin and her team are planning further research to identify the mechanism behind caffeine's protective effect and to find other ways to prevent ototoxicity.

In time, it may no longer be necessary for someone who needs one of these damaging yet life-saving antibiotics to choose between life and living without hearing.

Putting the Medication Puzzle Together

Improving Hospital Care Outcomes

Being released from the hospital seems like the end of an ordeal. But when her mother came home from a stay in the intensive care unit, WSU nursing instructor Cindy Corbett saw for herself how perplexing, even dangerous, the transition can be.

DESPITE HER TRAINING AS A NURSE, Dr. Corbett found herself struggling to straighten out which medications her mother needed at what dosages and when they had last been administered. Each of the care providers she contacted had only a partial picture of what her mother needed. She knew that if she was having trouble putting the post-hospital medication puzzle together, others would be having problems too.

She decided to do something about it. Transitional care became one of her passions—and the topic of several NIH grants. Dr. Corbett's research has also been funded by the American Society of Health-System Pharmacists' Research and Education Foundation, the Robert Wood Johnson Foundation, and the Agency for Healthcare Research and Quality.

With the state's chronic care management model as a starting point, she is finding better ways to help patients understand their medications when being discharged from the hospital and communicate an accurate medication list to their local health care providers.

With better medication management will come fewer hospital readmissions, lower healthcare costs, and ultimately better health for many people—a win for everyone.



Fighting Cancer, the Ultimate Foe

Understanding the Bases of Disease

Cancer cells are like villainous cyborgs in an action film: they simply won't die.

ENTER DR. WEIHANG CHAI, CANCER-FIGHTING HERO. The assistant professor in the School of Molecular Biosciences has discovered a way to make cancer cells mortal.

The secret lies in a protective DNA protein structure that exists in all human cells. Called "telomeres," these structures shield the ends of chromosomes and safeguard cells' genetic information from damage. Every time a normal cell reproduces, a snippet of the telomere is lost. When the telomere becomes short enough, the cell stops growing and eventually dies.

In a cancer cell, something prevents the telomere from shortening. The cell can reproduce again and again and keep on growing.

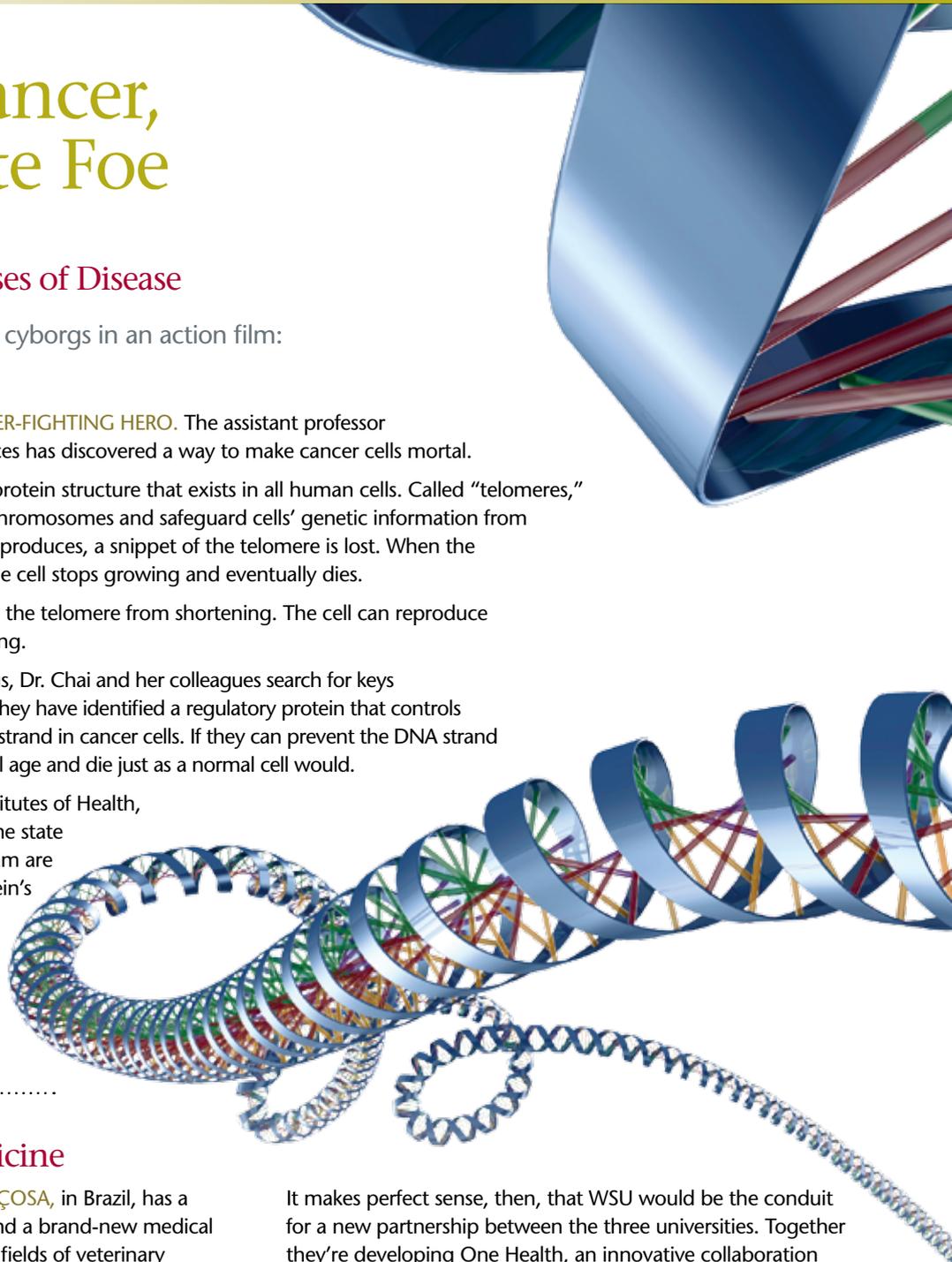
In a lab on the WSU Spokane campus, Dr. Chai and her colleagues search for keys to the telomere's persisting length. They have identified a regulatory protein that controls the continual lengthening of a DNA strand in cancer cells. If they can prevent the DNA strand from lengthening, the cancer cell will age and die just as a normal cell would.

With funding from the National Institutes of Health, the American Cancer Society, and the state of Washington, Dr. Chai and her team are forging a strategy to block the protein's function. Her discoveries may lead to breakthroughs in cancer therapy, as well as new ways to fight another enemy: aging.

One Health, One Medicine

THE UNIVERSIDADE FEDERAL DE VIÇOSA, in Brazil, has a well-recognized veterinary school and a brand-new medical school. WSU's own well-recognized fields of veterinary medicine and global animal health have longstanding research collaborations with UFV and a global health partnership with the University of Washington.

It makes perfect sense, then, that WSU would be the conduit for a new partnership between the three universities. Together they're developing One Health, an innovative collaboration between veterinary medicine and human health professionals to improve the intertwined lives and well-being of animals and people alike.



ENSURING ENVIRONMENTAL AND ECONOMIC STABILITY



Adding Profitability to Biofuels

Making Clean Energy Viable

Can the ubiquitous evergreen trees and abundant crops of the Pacific Northwest cut the United States' reliance on petroleum? Maybe—if questions of economic viability can be answered.

WSU RESEARCHER XIAO ZHANG AIMS TO ANSWER those questions with a “yes.” While converting lignocellulosic biomass (that is, plant matter) to biofuel is a promising concept, commercial implementation on a large scale isn't yet economically viable. The production process is just too expensive.

To fill the profitability gap, Dr. Zhang is working to develop value-added byproducts of biomass-to-biofuel conversion.

Funded by the Sun Grant Program Western Region, a program of the U.S. Department of Transportation, Dr. Zhang's team in the Bioproducts, Sciences, and Engineering Laboratory (pictured below), a joint effort of Pacific Northwest National Laboratory and WSU Tri-Cities, is exploring ways to produce plant-based phenolic compounds that could replace petroleum-based phenol in paint, printer ink, adhesives, and rubber.

Where biofuel production is not cost-effective, these valuable co-products could make the difference.

By using Douglas fir, the predominant softwood in the Pacific Northwest region, and corn stover, which can be grown locally in the Palouse region, Dr. Zhang's research has the potential to help farmers with economic diversification—and take the biomass industry to the next level.



Answering the Toughest Transportation Questions



Making Smart Policy Through Smart Technology

The nation's social and economic lifeblood rumbles along on 2.6 million miles of paved roads,¹ yet the economic importance of any given highway is difficult to quantify. If a snowstorm socks the region, does it cost more to keep a highway clear or shut it down for a day? Is a damaged road really worth repairing?

KENNETH CASAVANT, professor of economics at WSU Pullman, knows how to find the answers.

His current research aims to put these answers right at the fingertips of the decision-makers who need them.

Dr. Casavant is the director of the federally funded Freight Policy Transportation Institute (FPTI) and the University's transportation research group. With a team of co-researchers, he is developing a web-based tool that will quantify and visualize such transportation factors as day-to-day vehicle volumes, loading trends, bottlenecks, total cargo value, and even truck reliability.

Using that information, planners and public agencies can estimate the economic impact of improvement on a given roadway and provide for future growth.

Strategically planning and prioritizing repairs, upgrades, and maintenance can pay big dividends. For example, the FPTI's recent study of two weather-caused temporary highway closures in Washington state revealed loss of economic output, employment, state tax revenue, and personal income totaling millions of dollars.

Dr. Casavant's work could turn those lost millions into dollars saved.

1. American Road and Transportation Builders Association:
artba.org/about/transportation-faqs/#9

A man with glasses and a light blue shirt is smiling and holding a circular, dark asphalt binder sample. He is standing in front of a large, complex industrial machine with various rollers and components. The machine appears to be used for testing or processing asphalt materials. The background is slightly blurred, focusing attention on the man and the sample.

An Innovative Asphalt Binder

Finding Economically Sustainable Solutions

Every year, the United States uses more than 500 million tons of asphalt pavement to build and repair roads and parking lots.¹ It's an essential investment—and at \$700-\$800 per ton, a costly one. And traditional petroleum-based asphalt binders are only becoming scarcer and costlier.

DR. HAIFANG WEN, director of the Washington Center for Asphalt Technology, is poised to reduce not only asphalt's cost, but also its environmental impact. His research team has found an innovative substitute for crude oil in the production of asphalt binders: leftover cooking oil.

By using waste cooking oil from restaurants' deep-fryers, which is 1/3 the price of crude oil, Dr. Wen's team can make an asphalt binder that is as low as \$200 per ton.

Used vegetable oil isn't the only waste product that can be taken out of circulation by this innovation: the bio-based asphalt binder can be mixed with the typical aggregate used in roadways or with recycled material such as sidewalks and steel slag from mills. With funding from the Department of Transportation, Dr. Wen plans to develop an asphalt made entirely of recycled materials.

Both federal and state agencies see promise in Wen's work, and a road trial is currently underway.

1. National Asphalt Pavement Association:
asphaltpavement.org/index.php?option=com_content&view=article&id=14&Itemid=33

Self-Healing Power Grids



Moving Toward a More Reliable Power System

On a hot summer day in 2003, a falling tree branch in Ohio triggered a power outage that cascaded across eight U.S. states and into Canada, leaving 50 million people without electricity, some of them for days. Today, thanks in part to WSU research, the electrical grid has the smarts to avert such a disaster.

IN THE FUTURE, the grid will be able to do even better. Chen-Ching Liu, of the Energy Systems Innovation Center (ESIC) at WSU Pullman, directs a multidisciplinary research team that aims to create a truly smart national power grid.

The 26 members of ESIC research social and economic factors, clean power sources, cybersecurity, high-performance computing, data collection and delivery, decision-making processes, grid operation, and software development.

This holistic approach helps create not only smart technology, but also smart public policies.

With the smart grid envisioned by WSU researchers and collaborators, power disruptions would be vanishingly rare and limited to seconds or minutes (rather than hours or days) as the grid predicts the confluence of factors that cause blackouts and heals itself with limited human intervention.

The NSF has recognized the potential of the University's work by awarding a STEM scholarship grant that provides scholarships to new power engineering students.

New software technologies developed by Dr. Liu and his students are now being tested on major power grids in the United States.

Printing New Bones

Pioneering New Materials

Let's say that one day, in the not too distant future, you need surgery—replacement of a worn-out knee joint or repair of a badly broken bone. Thanks to innovative materials developed at Washington State University, your doctor could have replacement bone tissue made to order in a 3-D printer.

THIS REVOLUTIONARY CONCEPT is the brainchild of Susmita Bose, a researcher in the University's interdisciplinary Materials Science and Engineering Program. Dr. Bose's innovative materials blend a micro-scale metallic scaffold with resorbable ceramic compounds.

In vitro tests have shown that the metal/ceramic compound acts as a scaffold for new bone to grow on and ultimately dissolves as it's replaced by new bone cells.

Unlike traditional titanium implants, which can eventually degrade bone in weight-bearing applications, these materials have the potential to restore the natural strength of the surrounding bone.

Dr. Bose recently received a five-year, \$1.8 million National Institutes of Health grant to improve the way the bone implants integrate into the body.



Biofuel Innovation

A National Collaboration

The state of Washington has long been at the forefront of American aviation technology. Washington State University's successful bid for the new FAA Center of Excellence for Alternative Jet Fuels and the Environment adds to that strength and brings the University's unique expertise to the forefront of the fledgling biofuel industry.

[WSU PARTNERED WITH MIT](#) to win the bid; the two universities collaboratively lead a coalition of 14 other universities and more than 50 industry and national laboratory partners across the United States.

Their aim? To develop environmentally sustainable, cost-effective biofuel for the aviation industry.

The FAA Center of Excellence—known as ASCENT—is finding innovative ways to use a wide range of biomass and feedstocks as sources for jet fuel production.

Headquartered in the Bioproducts, Sciences, and Engineering Laboratory (BSEL) at WSU Tri-Cities, the center collaborates closely with the U.S. Department of Energy's Pacific Northwest National Laboratory (PNNL).

PNNL brings expertise in thermal processing, catalysis, and fungal biotechnology. WSU researchers bring expertise in biomass production, pretreatment, and conversion; process integration; and microbial, algae, and plant biotechnology.

The Center of Excellence is expected to be funded by the FAA with at least \$40 million over the next 10 years.



Matter at the Extremes

Research and Graduate Education at the Institute for Shock Physics

What happens to the materials that lie deep in the hot, dense interior of Saturn? The Institute for Shock Physics is perfectly equipped to find out. And the answer is more relevant on Earth than you might suspect.

RESEARCH ON MATTER UNDER EXTREME COMPRESSION and unusual conditions has a wealth of applications, from developing new nanomaterials to making vehicles and structures that can withstand crashes and disasters.

With a distinguished history spanning 55-plus years, Washington State University is widely recognized as the academic leader in shock wave research.

Graduate students, postdoctoral fellows, and faculty members at the Institute for Shock Physics conduct interdisciplinary research—spanning the fields of physics, chemistry, materials science, solid mechanics, planetary sciences, and applied mathematics—using the institute’s state-of-the-art experimental and computational capabilities. Real-time measurements are used to examine and understand physical and chemical changes in solids and liquids subjected to very rapid and large compressions.

Partnerships with researchers at national laboratories such as Los Alamos, Lawrence Livermore, and Sandia foster collaboration, professional interaction, and innovative ideas.

The institute’s unique research and learning opportunities develop well-educated and rigorously trained scientists who will move on to successful professional careers and find new answers to the grand challenges of our time.



Improving Fruit Cultivars Online

Washington, of course, is famous for its apples. Together with citrus, apples and related tree fruits comprise a \$12.7 billion industry in the United States. Staying ahead of diseases and pests, not to mention the search for the perfect combination of productivity and flavor, makes constant improvement a necessity.

[WSU RESEARCHER DOREEN MAIN](#), along with a team of fellow horticulture scientists, has created an online database to help growers around the world address these challenges.

The tree fruit Genome Database Resource is the world's first central repository for citrus genomics and genetics data. All told, it provides genomic, genetic, and breeding resources for 22 major horticultural crops. It also provides a plethora of software tools and bioinformatics resources to scientists who need genetic data to improve fruit varieties.

Dr. Main and her WSU collaborators built the website together with researchers at Clemson University, the University of Florida, the Boyce Thompson Institute for Plant Research, and North Carolina State University. Funding by the U.S. Department of Agriculture Specialty Crop Research Initiative, the Washington Tree Fruit Research Commission, and the Citrus Research and Development Foundation backed the project.

Next up: the Grower's Toolbox, an online resource of weather, soil, and environmental conditions, which will help fruit growers around the world choose the best varieties for their growing conditions.



Crop Protection Without Pesticides



Growing Healthy Food, Protecting the Environment

One of the biggest problems with pesticides is collateral damage: they often kill innocent insects along with the pests they're meant to take out. There's also the potential for toxicity to humans. Unfortunately for the agricultural industry, the only available pesticide for the root-knot nematode—one of the most economically damaging plant parasites, affecting more than 2,000 plant species—is a highly toxic chemical that carries health and environmental risks.

BUT THERE MAY BE A SAFER ALTERNATIVE. WSU cell biologist and geneticist Jennifer Watts plans to harness one of the building blocks of life to disarm the enemy without causing collateral damage.

Dr. Watts' research focuses on lipids: hydrocarbon-based molecules that are essential to the structure and function of living cells. She recently discovered that a specific dietary fatty acid (one of many types of lipids) may cause sterility in nematodes. Now, supported by an award from the Genetics Society of America, she has teamed up with WSU plant pathologists to verify precisely what happens when parasitic nematodes consume this lipid.

If the hypothesis holds true, the next step will be to develop transgenic crops with genes that express that lipid. Nematodes that attack the new crop would die without reproducing—quickly and permanently ending the assault.

Dr. Watts' research has far-reaching implications. Understanding the role of lipids in cell signaling and regulatory pathways could be the key to solving problems ranging from reproductive issues to obesity and associated diseases.

Protecting Native Pollinators



Defending the Future of Agriculture

The alarming phenomenon of colony collapse disorder highlighted the importance of insect pollinators in agriculture—and showed how dangerous it could be to rely on a single organism. Fortunately, honeybees aren't the only important pollinators of agricultural crops. The future security of agriculture could depend on healthy populations of native pollinators.

ONE OF THESE IS THE ALKALI BEE. Nearly 17 million alkali bees, the largest concentration in the world, nest in south central Washington's Touchet Valley, where they are the primary pollinators of the region's alfalfa crop. However, in other regions, these and other native pollinators are declining.

Entomologist Douglas Walsh is studying ways to protect these vulnerable populations.

A proposed highway project cuts right through the alfalfa acreage that provides the alkali bees' favored nesting grounds. Recognizing the native bees' importance, the Washington State Department of Transportation (WSDOT) funded a study to protect them.

Dr. Walsh's research is helping the state find the optimal route for the highway. Through studying the bees' behavior, he has also found a simple, practical solution that could reduce road-kill deaths.

Alkali bees normally fly close to the ground, making them vulnerable to vehicle traffic. But if they're given a higher launching point, they tend to maintain altitude until they find a plant they want to land on. The logical solution: a barrier net that runs along the roadside at the edge of the alfalfa fields. When the bees reach the top of the barrier, they should fly right over the highway traffic.

Dr. Walsh's research team (based in WSU's Irrigated Agriculture Research and Extension Center in Prosser) is currently assessing the feasibility and performance of the barriers.

Their recommendations will inform construction plans that meet everyone's needs: the state transportation department, the farmers, and the general public.

Making Packaged Food Safer, More Nutritious, and Delicious

Foodborne illnesses sicken more than 8.9 million Americans each year and claim more than 2,300 lives. In addition to human suffering, the illnesses exact a staggering economic toll—more than \$15.6 billion in medical expenses, lost income, and more according to U.S. Department of Agriculture (USDA) estimates.¹

DR. JUMING TANG IS FINDING new ways to make our food safer. The Regents Professor and Distinguished Chair of Food Engineering has developed a microwave-assisted pasteurization process that reduces pathogenic bacteria by a million fold.

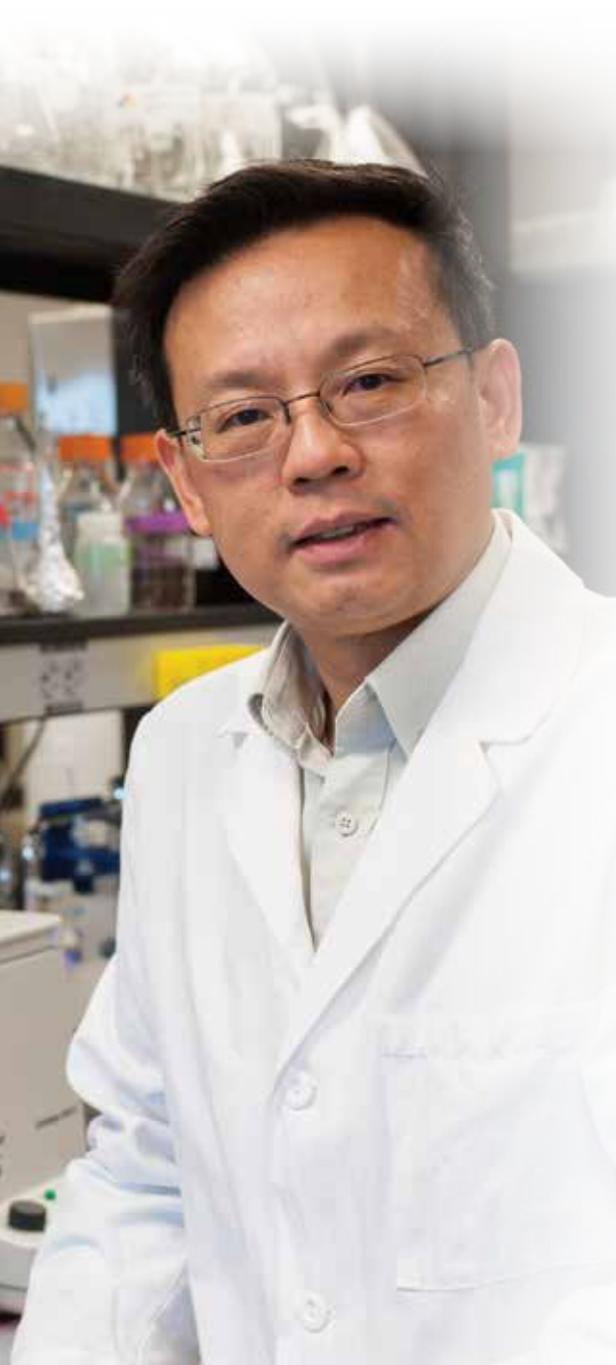
Supported by a \$5 million USDA National Institute of Food and Agriculture (NIFA) grant, Dr. Tang's research could revolutionize food preservation and packaging. His 915 MHz Single-mode Microwave Assisted Thermal Sterilization (MATS) and Pasteurization (MAP) processes preserve foods faster and at lower temperatures than traditional canning methods.

Food quality remains high—with better flavor and nutrition—but dangerous pathogens don't stand a chance.

Dr. Tang has dedicated his career to exploring the use of microwave and radio frequency energy for food safety and pest control. The MATS and MAP food preservation methods are the culmination of two decades of research.

Their benefits are clear to food processing industry leaders, who are partnering with Dr. Tang to bring the technology to market.

1. "USDA: U.S. Foodborne Illnesses Cost More Than \$15.6 Billion Annually," Dan Flynn, *Food Safety News*, October 9, 2014.



A Unique Research Partnership

Providing Answers for Washington, the Nation, and the World

The U.S. Department of Agriculture's Agricultural Research Service (USDA-ARS) funds more than 800 research projects annually at nearly 100 research locations, many of them jointly operated by universities.

AT WASHINGTON STATE UNIVERSITY, unlike most research sites, USDA-ARS scientists work side by side with WSU faculty in labs on campus.

It's a fruitful partnership, and you're probably munching those fruits on a regular basis.

The Western Wheat Quality Laboratory does what may be the most delicious research in the world: they bake batches of cookies daily to evaluate the milling and baking quality of wheat. Researchers in this lab ensure the economic vitality of the wheat industry in seven western states by optimizing wheat cultivars for commercial productivity and for the baking qualities desired by consumers.

WSU researchers have also developed some of the Northwest's most productive commercial wheat varieties. \$5 million in funding from Washington Grain Commission will provide WSU and USDA-ARS scientists with 20,000 square feet of new greenhouse and lab space to make sure the innovation continues.

Essex, a high-yielding new variety of lentil, was developed by scientists in the Grain Legume Genetics and Physiology Research Unit. The lab also seeks to develop commercial crops that provide erosion control and works on mapping the genes in legumes to identify disease resistance and quantify traits such as time to maturity, resistance to environmental stress, and seed size.

The Animal Disease Research Unit searches for solutions to infectious diseases that inflict devastating livestock losses worldwide. Vector-borne diseases are one of the lab's specialties; they're currently developing new methods to prevent the spread of diseases carried by ticks.

This is only a small look at WSU's USDA-ARS partnership. See research.wsu.edu for a wider view of the University's research.

Happy Christmas Trees, Happy Holidays



Growing the Economy

Last year's Capitol Christmas Tree—an 88-foot-tall Engelmann spruce harvested from the Colville National Forest in Pend Oreille County, Washington—went through quite an ordeal. Cut on November 1, it spent 25 days on a flatbed trailer, making ceremonial stops across the country before arriving at the nation's capital.

IT MADE THAT JOURNEY with an array of small sensors in its canopy. Placed by Katie McKeever, a graduate student in plant pathology, the sensors continually recorded temperature inside the tree canopy.

Forest Service technicians from the Colville National Forest traveled with the tree, taking periodic samples of small twigs, which were sent to Gary Chastagner's lab at the Washington State University Research and Extension Center in Puyallup. The samples were then weighed, carefully dried in an oven, and weighed again to determine how much moisture the tree lost along the way.

Why all this effort to monitor one gigantic Christmas tree?

It's part of Dr. Chastagner's long-running research on improving the quality of cut Christmas trees, which are a \$145 million-plus industry in Washington and Oregon. The national tree's journey is more epic than most, but despite its massive size and long travel, the stresses it endured are not so different from those that your own Christmas tree will face as it goes from the farm to your living room.

Generally speaking, the more moisture a Christmas tree retains, the longer it keeps its needles. And if picking needles out of your carpet is a post-holiday ritual you'd rather skip, you and your floor will both benefit from a better tree.

The data gathered by WSU researchers will inform guidelines that help tree producers improve the quality of Christmas trees and traditions across the nation.

Measuring the Value of a Smile



Happier Humans

Humanity can be roughly divided into two personality camps: introverts and extroverts. Generally speaking, introverts prefer small groups of friends, enjoy stretches of solitude, and may feel drained by the expansive socializing that fuels the more numerous extrovert camp.

THERE'S A COMMON STEREOTYPE that assumes introverts are antisocial or fundamentally unhappy. But studies show that introverts aren't antisocial; like extroverts, they experience higher levels of happiness when they engage in outgoing behaviors. However, those studies were done in the United States and other Western countries with similar cultural values.

WSU professor Timothy Church wanted to see if these personality-related behaviors transcended culture.

With funding from the National Science Foundation, Dr. Church and his team in the WSU College of Education adapted a standard psychological survey to measure the behavior, mood, and personality traits of college students in Venezuela, China, the Philippines, Japan, and the United States.

Despite the sharply differing cultural and social structures of each country, results were the same across the board. People reported more positive emotions in daily life when they felt more extroverted or took outgoing actions—for instance, when calling an old friend or smiling at a passerby on the street.

And regardless of their baseline levels of introversion or extroversion, the students in Dr. Church's study reported traits associated with higher happiness when they were able to choose their own behavior—in other words, when they felt free to be themselves.

Quantifying this knowledge may improve interpersonal and international relationships, and could especially benefit complex, increasingly diverse societies like the United States. It can also bring better health: happier people tend to live longer and healthier lives.¹

1. "Happy People Live Longer: Subjective Well-Being Contributes to Health and Longevity." *Applied Psychology: Health and Well-Being*, vol. 3:1, March 2011.

Ensuring Access and Achievement

WSU brings education and opportunity to underserved regions of the state.

WSU TRI-CITIES RECEIVED OVER \$16 MILLION IN FEDERAL FUNDING for programs to help students in educationally isolated rural schools in the inland northwest. **GEAR UP**, as one of the programs is called, reaches over 50 rural schools, giving middle-school and high-school students and their families guidance on how to prepare for college.

WSU NORTH PUGET SOUND AT EVERETT now offers four bachelor's degrees for transfer students at the Everett University Center, located on the campus of Everett Community College.

These high-demand degrees—mechanical engineering, electrical engineering, hospitality business management, and integrated communication—help advance the Puget Sound region's technology, manufacturing, and research-based industries.



RESEARCH COLLABORATIONS WITH PRIVATE INDUSTRY BOOST THE STATE'S ECONOMIC HEALTH AND ANSWER COMPLEX SOCIETAL CONCERNS.

Sponsored Research

Leading Private-sector Research Projects in FY2013-2014

Industry Sponsor	Research Project
Avista	Smart Home-Based Analysis and Automation for Energy Efficiency Principal investigator: Anurag Srivastava, \$152,646
Boeing	Design of Ice Phobic Coating Using Multiscale Simulations Principal investigator: Santanu Chaudhuri, \$80,000
CPB	FY14 Television Community Service Grant Agreement, Television Local Service Grant Principal investigator: Marvin Marcelo, \$703,245
Hop Research Council	IPM of Hop Powdery and Downy Mildew Principal investigator: Gary Grove, \$60,000
Leawaina Camel Hospital	Leawaina Camel Hospital Project Principal investigator: Warwick Bayly, \$1,500,000
Syngenta	Support Concerning Onion Post Harvest, Sweet Corn Trial, and Potato Psyllid Trial Principal investigator: Timothy Waters, \$27,000
United Air Lines	Fatigue Risk Management System Flight Studies Principal investigator: Gregory Belenky, \$752,073
Washington Concord Grape	Examining Potential Causes of Replant Disorder in Concord Grape Principal investigator: Joan Devenport, \$47,825
Yakima Valley Memorial Hospital	Staff Assignment at Yakima Valley Memorial Hospital Principal investigator: Angela Steward, \$123,515

Leading Washington Commodity Commission Research Projects in FY2013-2014

Commission Sponsor	Research Project
Washington Dairy Products Commission	Evaluation of Narrow Buffers for Narrow Agricultural Waterways Principal investigator: Chris Benedict, \$30,342
Washington Grain Commission	Improving Spring Wheat Varieties for the Pacific Northwest Principal investigator: Michael Pumphrey, \$160,258
Washington Hop Commission	Clean Plant Center Northwest Support Principal investigator: Kenneth Eastwell, \$44,570
Washington Mint Commission	Pest and Beneficial Mite Studies on Mint Principal investigator: Doug Walsh, \$12,547
Washington Potato Commission	Postharvest Quality of Clones in the Western Regional Potato Variety Development Program Principal investigator: Norman Knowles, \$56,6000
Washington Red Raspberry Commission	Red Raspberry Trellising Demonstration Plot for Development of Automation Technologies Principal investigator: Manoj Karkee, \$72,007
Washington Tree Fruit Research Commission	Apple Scion Breeding Principal investigator: Katherine Evans, \$163,233
Washington Wine Commission	Management of Phenolic Compounds in Vineyard and Winter: Investigation of Mechanical Pruning Principal investigator: James Harbertson, \$151,309

Core Research Labs and Facilities at WSU

The University's core lab units (of which this report can mention only a few) make specialized research instrumentation and services available to WSU faculty and student researchers and to external clients.

The [Center for Nuclear Magnetic Resonance \(NMR\) Spectroscopy](#) provides access to state-of-the-art NMR instrumentation, which determines the spectrum (or fingerprint) that reveals the identity and structure of molecules.

Funded by grants from the National Institutes of Health (NIH), the National Science Foundation (NSF), the Battelle Memorial Institute, and the Murdock Charitable Trust, the lab's equipment offers the valuable flexibility of being able to study both solids and liquids.

The lab's NMR instruments recently provided data for a study on the structure of anti-cancer compounds in plants and for research on microorganisms producing triacylglycerides, an important component in biofuel production.

The [Franceschi Microscopy and Imaging Center \(FMIC\)](#) plays an essential role in the University's life sciences and engineering research. The center also teaches advanced classes in microscopy. Over the past two fiscal years, its three confocal microscopes have been shared by 104 researchers, whose total funding from the NSF, NIH, and other sources exceeded \$27 million.

In the realm of DNA sequencing, one size definitely doesn't fit all. The [Laboratory for Biotechnology and Bioanalysis](#)

provides two next-generation sequencing platforms for the University's researchers in genomics and molecular biology.

With the two systems' complementary abilities, WSU researchers are reaching further and diving deeper than ever before. Dr. Claire Coyne, in the Department of Crop and Soil Sciences, is well on her way to sequencing the entire pea-plant genome. Dr. Mike Konkel, in the School of Molecular Biosciences, is interrogating bacterial genomes in great detail.

The [Biomolecular X-Ray Crystallography Center \(BXCC\)](#), first established as a lab in 1994, provides biophysical and biochemical data for a wide range of research projects. It is also a center of teaching and outreach. WSU faculty and students train on the equipment, and the lab mentors high-school students, giving them hands-on experience of the joy and challenge of scientific research.

The center collaborates with numerous organizations, including the Pacific Northwest National Laboratory (PNNL), the U.S. Navy Research Center, the NIH, and several universities. A \$1.5 million investment from the NSF recently gave the BXC Center a complete line of high-throughput equipment, making it one of the most advanced university research labs in the nation.

The [Stable Isotope Core Facility](#) allows researchers to address critical questions by measuring naturally occurring, stable isotopes of important elements in plant, soil, water, and atmospheric samples. Established with more than \$1.3 million in funding from the NSF, the facility provides analyses for scientists from all four of the University's campuses, contributing to research awards totaling over \$15 million.

The facility also provides unique, hands-on research training for students. Over 40 graduate students have been trained there, resulting in 27 theses and dissertations.

The [Nuclear Radiation Center](#) operates a one-megawatt TRIGA nuclear research reactor and provides neutron activation analysis, x-ray diffraction, mass spectrometry, gamma irradiation, radiochemistry, and alpha spectroscopy for WSU research projects. It also produces radiotracers and isotopes for universities and industries nationwide.

The center fuels one of the best radiochemistry graduate programs in the United States. Half of the nation's doctoral degrees in radiochemistry are awarded by WSU.



ELEVEN COLLEGE DIVISIONS PURSUE RESEARCH, EDUCATION, AND PUBLIC SERVICE ON EACH OF THE UNIVERSITY'S FOUR RESEARCH CAMPUSES.

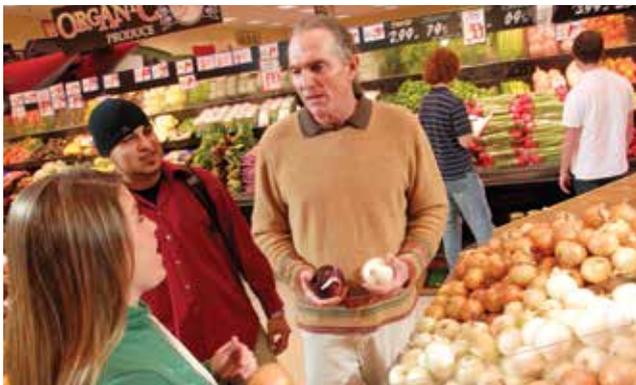
AGRICULTURAL, HUMAN, AND NATURAL RESOURCE SCIENCES

The College of Agricultural, Human, and Natural Resource Sciences (CAHNRS) exemplifies Washington State University's land-grant research and education mission. With extension offices in nearly every county in Washington state, CAHNRS plays a vital role in making the benefits of the University's research available to the entire state.

The research done in CAHNRS contributes to a safer, more abundant, and more affordable food supply; promotes the well-being of individuals, families, and communities; enhances the sustainability of agricultural and economic systems; and cultivates the stewardship of natural resources and ecological systems.

For example, the five institutes, laboratories, and centers that comprise the Agricultural Research Center improve the state's agricultural practices through studies in precision and automated agricultural systems, composite materials and engineering, and the molecular biology and biochemistry of plants.

The climate-controlled plant growth facilities on the WSU Pullman campus serve many departments—plant pathology, the Institute of Biological Chemistry, and crop and soil sciences, to name a few. Other research units include an on-campus orchard, the nation's largest on-campus organic farm, facilities for dairy and beef research, and multiple farms for seed and crop experimentation.



ARTS AND SCIENCES

In 2012, Washington State University merged science and liberal arts to form the College of Arts and Sciences—a college with a truly multidisciplinary nature.

The faculty are exceptional leaders and researchers: professional society fellows, international cultural experts, presidential appointees, cutting-edge scientists, Fulbright Scholars, and award-winning authors. Their research is wide ranging, advancing the frontiers of knowledge in such enduring issues as sustainability, health, security, sociocultural systems, and natural environments.

Recent research highlights include developing new drug therapies for alcoholism, seeking insights into reef ecosystem recovery, and discovering how complex societies develop. The Institute for Shock Physics does cutting-edge research on the chemical changes in solids and liquids under very rapid and intense compressions.

The College of Arts and Sciences is also a repository of knowledge about the natural world and human achievements. The Marion Ownbey Herbarium preserves nearly 350,000 specimens of plants and lichens; the Conner Museum of Natural History houses more than 65,000 bird and mammal specimens; and the Museum of Art brings works of cultural, historical, and scientific significance to campus.



BUSINESS

The Carson College of Business not only has an excellent teaching program, but also conducts research that drives the economic well-being of the state of Washington and the nation. Business-related research at WSU fosters academic and economic advances that improve the function of organizations around the globe.

The School of Hospitality Business Management ranks ninth in the world for articles contributed to scholarly journals.¹ The college has AACSB International accreditation at all degree levels, international offerings in six global locations, and ranks in the top 25% of undergraduate business programs.²

The Carson College's Center for Behavioral Business Research brings together industry leaders, academics, and students to study behavioral and consumer issues that affect organizations across the globe. Some of the topics studied at this center include the interface between retailers, brands, and consumers; the interaction between humans and technology; and the influence of perceived environmental impacts on consumer decisions.

1. *Journal of Hospitality & Tourism Research*

2. *U.S. News & World Report*



COMMUNICATION

The Edward R. Murrow College of Communication is committed to pursuing knowledge related to the complex and multifaceted nature of communication.

Faculty are top-ranked nationally by ComVista for their research on advertising effects, substance abuse prevention, and media literacy. Other research topics include emerging technologies, media law and ethics, and the role of organizational politics.

Research in the Murrow College directly shapes the emerging generation of communicators. The college has won national and regional Emmys for student television production, is ranked fourth nationally in television news, and is ranked first in the Northwest for its public relations sequence. In 2012, the journalism program was ranked among the top 25 nationally by *NewsPro Magazine*.

Three nationally acclaimed media outlets are housed in the college: Northwest Public Radio, Northwest Public Television, and the Murrow News Service. A student-produced television newscast, aired daily in Pullman, is one of only a few such programs in the nation.



EDUCATION

The College of Education advances the field of education through research-based ethical and theoretical frameworks and close connections with classroom teachers and practitioners. Faculty in the college conduct research in science and mathematics education, testing and measurement, moral reasoning, and cross-cultural personality research, to name just a few topics.

The college's Department of Educational Leadership, Sport Studies, and Educational/Counseling Psychology is a nexus for the latest advances in cognition measurement, kinesiology, and program evaluation. The award-winning faculty in the Learning and Performance Research Center evaluate assessments for government agencies, school districts, corporations, and testing companies, and conduct methodological studies.

Research in the Pacific Northwest Center for Mestizo and Indigenous Research and Engagement—the first such center in the nation—has the potential to improve social, economic, educational, and political conditions for Latino/Mestizo and Native/Indigenous communities, both locally and globally.



ENGINEERING AND ARCHITECTURE

The Voiland College of Engineering and Architecture is a major research engine at WSU. Solving critical issues in energy, environment, health, and security are priorities for the college's researchers, who do world-leading work in advanced materials, smart-grid power networks, renewable energy and energy conversion, air and water quality, sustainable infrastructure, and engineering for health.

The University's globally recognized work in atmospheric and environmental research, outreach, and education is centered in the Voiland College.

Researchers directly impact the economy with their work in composite materials for airplane and aerospace manufacturing, biomedical engineering, new battery technologies, sustainable building materials, bio-computing, and crystal growth.

More than 40% of the \$1 billion wood-plastic industry in North America uses material formulations developed at WSU.

This year, with funding from the U.S. Department of Energy, the college established the Energy Systems Innovation Center to study the social and economic impacts of electrical energy.

WSU is one of a select few universities worldwide that were invited to present their research at the 2013 Paris Air Show.



HONORS COLLEGE

The WSU Honors College is growing the next generation of ground-breaking researchers.

Students enjoy the unique advantages of small classes and personal mentoring from their professors in a liberal arts-style undergraduate program focused on critical thinking, communication skills, and international connections in the University's research context. Almost 42% of honors students study abroad.

The honors thesis capstone project gives students an opportunity to pursue their own research and creative activities—and they are productive scholars and researchers. Honors College students are currently working on cancer diagnostics, catalysis, genomics, epigenetics, advanced materials, and autonomous vehicles.



MEDICAL SCIENCES

The recently formed College of Medical Sciences, based on the Spokane campus, conducts biomedical research in a number of fields, with internationally recognized work in neuroscience, molecular biology, and biochemical genetics.

Together with the University's longstanding expertise in pharmacy and nursing education, the College of Medical Sciences is the bedrock upon which the University plans to expand its medical education programs. A push toward accreditation as a professional school of medicine is underway.



NURSING

Patient-focused research at the College of Nursing aims to transform and improve health care for everyone. Areas of nursing faculty expertise include rural mental health, substance abuse, addictions, geriatrics, environmental health, transitional care, underserved populations, cultural competency in nursing, and childhood obesity.

Currently affiliated with more than 30 national and international investigators, the college's addiction research team is improving treatment and prevention of alcohol and drug addiction. The College of Nursing is also one of 10 schools chosen to participate in a national study evaluating the effectiveness of patient simulations in nursing programs.

Environmental health and sustainable health care are also priority topics. Faculty researchers are developing ways to decrease the environmental footprint not only of WSU's College of Nursing, but of nursing colleges around the United States.

With campus locations in Spokane, the Tri-Cities, and Vancouver, and distance-delivery sites in Walla Walla and Yakima, the college educates more than 1,000 students each year.



PHARMACY

Research thrives at the WSU College of Pharmacy. The college serves as a resource for medical practitioners in the state, connecting laboratory science with medical practice to maximize the positive effects of drugs and minimize the negative.

The college recently received a \$1.9 million grant from the Health Sciences and Services Authority of Spokane County to make advanced facilities available to local researchers.

Research at the College of Pharmacy helps solve and treat medical problems involving cancer, drug metabolism, rheumatoid arthritis and inflammation, tobacco cessation, immunology and immunotherapy, aging, and diabetes management. Programs emphasize novel drug targets, the pharmacology of drug interactions, drug discovery, and the potential of pharmacogenetics and pharmacogenomics in personalized medicines.

Spurred by growing demand, the College of Pharmacy is extending its doctor of pharmacy program to a satellite campus in Yakima, housed at the Pacific Northwest University of Health Sciences.



VETERINARY MEDICINE

The College of Veterinary Medicine operates one of the best-equipped teaching hospitals in the world.

Clinical faculty often collaborate with research faculty. The college's research on the basic processes of infectious diseases, neurobiology, physiology, and immunology informs new approaches to the control and treatment of both animal and human diseases.

The Washington Animal Disease Diagnostic Lab provides diagnostics, disease surveillance, and outreach in order to safeguard animal health, the food supply, and public health.

The college's highly productive research faculty attract \$3.13 in extramural funding for every dollar allocated by the state.



TOP ELEVEN PUBLISHING FACULTY

Name	Department	Publications 2011-2013
Shulin Chen	Biological Systems Engineering	83
Susmita Bose	Mechanical and Materials Engineering	67
Amit Bandyopadhyay	Mechanical and Materials Engineering	66
Jaak Panksepp	Integrative Physiology and Neuroscience	64
Mark G. Kuzyk	Physics and Astronomy	55
Diane Cook	Electrical Engineering and Computer Science	53
Ali Saberi	Electrical Engineering and Computer Science	49
Juming Tang	Biological Systems Engineering	48
Yong Wang	Chemical Engineering and Bioengineering	46
Sandip Roy	Electrical Engineering and Computer Science	45
Danial E. Baker	Pharmacy	45

LEADING INSTITUTIONS COLLABORATING WITH WSU

Institutions	Co-authored Publications 2011-2013
U.S. Department of Agriculture	421
University of Idaho	214
Pacific Northwest National Laboratory	178
University of Washington	178
Oregon State University	120
University of Minnesota	112
University of Florida	111
Michigan State University	95
Pennsylvania State University	95
University of California, Davis	88

THE ENTREPRENEURIAL SPIRIT OF WSU FACULTY HELPS
TO FUEL THE ECONOMIC GROWTH OF THE PACIFIC NORTHWEST.



M3 Biotechnology

SPARKED BY LEEN KAWAS'S RESEARCH AS A WSU DOCTORAL CANDIDATE, M3 Biotechnology is testing a drug that could cure the scourge of neurodegenerative diseases such as dementia, Parkinson's, and Alzheimer's.

M3's innovative small-molecule compound does something no other medicine can: repair damage that has already occurred. Tests in rodent models show dramatic restoration of cognitive and motor functions.

Dr. Kawas is co-inventor of the drug with WSU researchers John Harding and John Wright, the company's founders—and thanks to her entrepreneurial skill, was named CEO in 2014.

With her leadership, M3 has partnered with the Michael J. Fox Foundation and received funding from the Alzheimer's Drug Discovery Association, the state Life Sciences Discovery Fund, and private investors.

Next up, after satisfying FDA safety requirements, are clinical trials with funding from the WSU Research Foundation and, ultimately, pharmaceutical company partners.





Phytelligence

ROOTED IN RESEARCH BEGUN IN AMIT DHINGRA'S WSU LAB, the innovative plant propagation techniques of Phytelligence can do in only two years what used to take seven. In one year, Dr. Dhingra's method can produce 250,000 starts from a single plant.

Growers are already seeing the benefits. Phytelligence's fruit rootstocks and plantlets have a 50% better survival rate than traditionally grown plantlets. Genetic identification prevents varietal mix-ups that could otherwise take a grower years to discover.

Sterile growth environments remove the need for pesticides, fungicides, or insecticides during the propagation period. The process also uses less water; a million plants grown with Phytelligence's methods would save enough water to supply the San Francisco Bay area for a year.



3D-4U

YOUR VIEW OF FOOTBALL GAMES at WSU's Martin Stadium doesn't depend only on where you sit. Thanks to WSU start-up company 3D-4U, Cougar football fans can now choose their own personal view of sporting events both in real time and replay.

Sankar "Jay" Jayaram, the company's co-founder, opened the way for infinitely customizable interactive viewing with his research on virtual-reality technology in the University's School of Mechanical and Materials Engineering. 3D-4U isn't only for sports fans. Its successful debut in Martin Stadium also attracted interest from concert promoters and security companies.

Playable on 3D and 2D televisions and mobile devices, this second-screen fan interaction already has viewers looking for more.

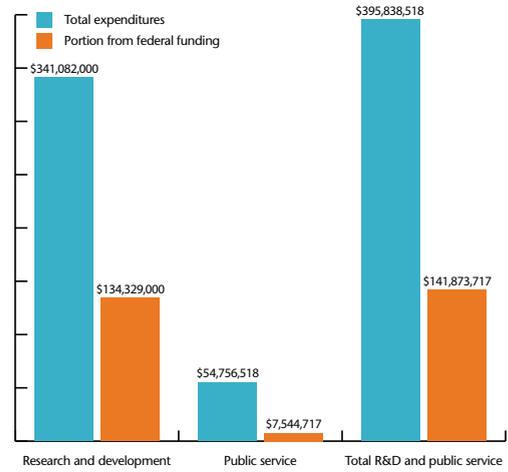
They won't have to wait long: 3D-4U just released a mobile app named iStadium™.

Discoveries that Pay Dividends

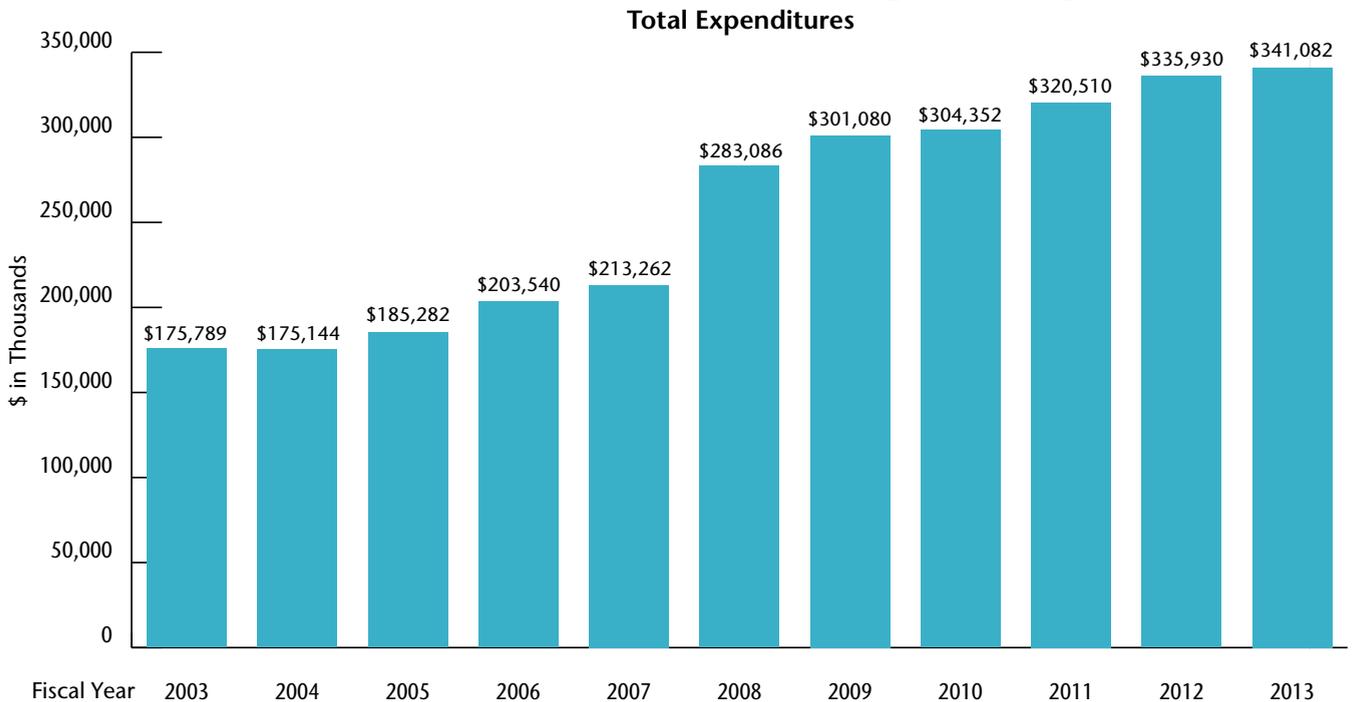
Washington State University research relies on the financial support of government, industry, organizations, friends, and alumni. Their generous sponsorship fuels a growing research agenda.

The discoveries, creativity, and entrepreneurial spirit of the University's scholars and researchers drive economic development throughout the Pacific Northwest.

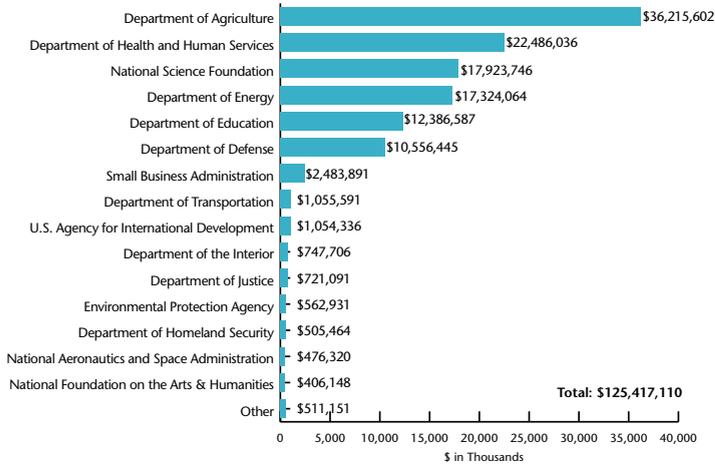
A Commitment to Discovery and Outreach
Fiscal Year 2013 Research and Public Service Expenditures



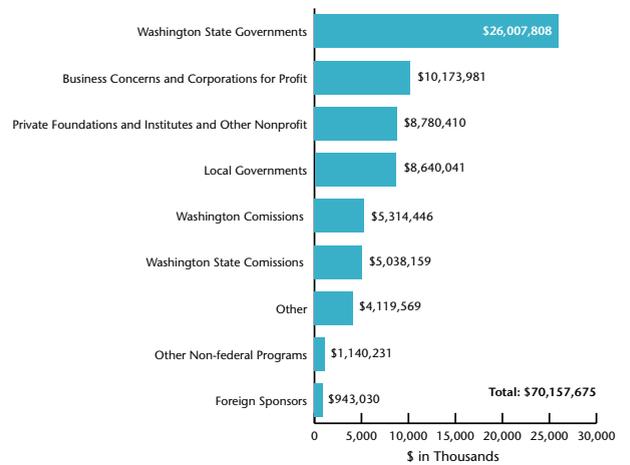
Consistent Growth in Research and Development Expenditures



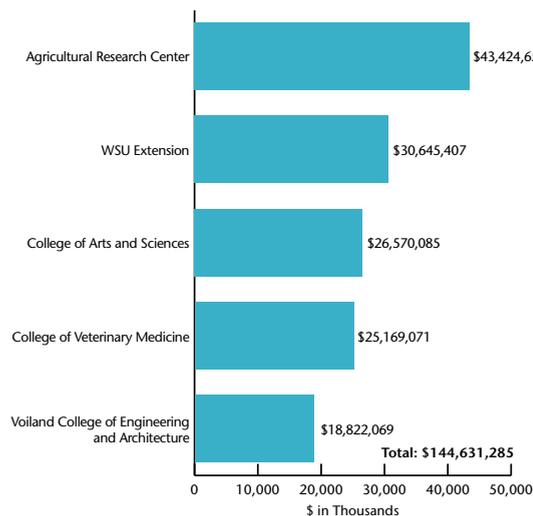
Significant Federal Funding for Research Fiscal Year 2014 Expenses by Federal Sponsor



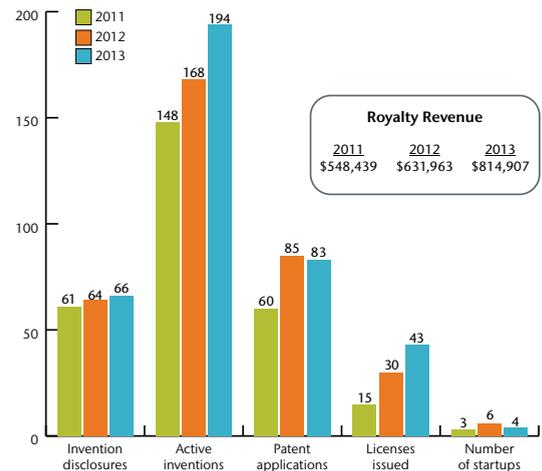
Broad Support from Non-Federal Sources Fiscal Year 2014 Expenses by Non-federal Program



Research and Public Service Spanning Many Disciplines Highest Sponsored Expenditures by Area/College for Fiscal Year 2014



Commercialization on the Rise



STATEWIDE IMPACT

WASHINGTON'S LAND-GRANT UNIVERSITY DELIVERS THE BENEFITS OF ITS RESEARCH TO PEOPLE THROUGHOUT THE STATE.

WSU PULLMAN

WSU Pullman, located among the rolling hills and rich fields of eastern Washington's Palouse region, is the University's flagship campus.

Established as the state's land-grant college in 1890, the Pullman campus is the foundation of the University's Tier I research status. WSU has also given Pullman its identity as one of the nation's quintessential college towns. Researchers in Pullman participate in the full range of the University's statewide, nationwide, and global research activities.



WSU SPOKANE

WSU Spokane is the University's Health Sciences Campus. In partnership with hospitals, industry, government, and other universities, researchers at WSU Spokane tackle some of the thorniest health challenges of our time.

WSU Spokane's innovative medical education model focuses on increasing access to primary care physicians in underserved populations. Spokane's medical and nursing students benefit from the University's research in behavioral health and performance, novel therapeutic strategies, and disease onset and progression.

The new Pharmaceutical and Biomedical Sciences Building, which houses the College of Pharmacy and newly established College of Medical Sciences, provides facilities for advanced imaging, mass spectrometry, and genomics. It also provides space for future expansion of the University's medical programs, which one day may include an accredited medical school.



WSU TRI-CITIES

Research at WSU Tri-Cities focuses on three key areas: K-12 STEM education, wine science, and sustainable energy.

The GEAR UP program at WSU Tri-Cities reaches over 50 isolated rural schools, giving middle-school and high-school students and their families essential guidance on preparing for college. The University's longstanding partnership with Pacific Northwest National Laboratory has helped WSU Tri-Cities researchers become national leaders in alternative fuels and cleaner energy sources.

A new wine science center was completed in 2015 on land donated by the Port of Benton. This world-class facility will be solely devoted to the challenges and opportunities faced by Pacific Northwest grape growers and winemakers.



WSU VANCOUVER

WSU Vancouver is the only four-year research university in southwest Washington. This urban research campus provides students of all ages with access to a strong education and opportunities to participate in innovative research mentored by WSU faculty.

With emphasis on applied and translational science and technology, leadership, and sustainability, WSU Vancouver researchers are making discoveries with impacts far outside the state. The topics being explored at WSU Vancouver are as varied as the hydrodynamics of mangrove swamps in the Mekong Delta, the management of conflict and revenge in the workplace, and the study of the hair cells of zebrafish for hearing loss prevention.



STATEWIDE IMPACT

RESEARCH AND EXTENSION CENTERS

Four WSU research and extension centers spread the benefits of the University's research across the state of Washington.

Agricultural research at these centers is supported largely by state and federal research grants and contracts—a public investment with enormous returns in land productivity, disease-resistant crops, and the conservation and safer use of chemical and water resources.

The **Mount Vernon Research and Extension Center** takes advantage of the location's unique mild, marine climate and rich alluvial soils for small-crop and weed research, looking for specific benefits for the local small and mid-sized farms in this area of rural-urban interface.

The 320-acre **Puyallup Research and Extension Center** houses the University's avian health and food safety laboratories and a plant and insect diagnostic lab.



In Prosser, the **Irrigated Agriculture Research and Extension Center (IAREC)** is a focal point for the USDA Agricultural Research Service (USDA-ARS) and the Washington State Department of Agriculture (WSDA). Research here focuses on innovative developments in irrigated agriculture, which accounts for an estimated two-thirds of the agricultural production in the state.

Interdisciplinary and interagency collaboration are natural things at IAREC, where faculty and staff from seven WSU departments work on-site with USDA-ARS, WSDA, and EPA scientists.

The **Tree Fruit Research and Extension Center** in Wenatchee houses the F. L. Overley Laboratory (horticulture, plant physiology, soil sciences, entomology, and plant pathology) and the USDA Tree Fruit Research Laboratory, among other laboratories and facilities, on its 200 acres.

WSU Extension offices located in most of the state's counties have eight main areas of focus: agriculture, communities, energy, youth and families, natural resources, health and wellness, gardening, and economic development. These focus areas are typically based on local resources and community needs.





Harnessing the Power of Philanthropy

The Washington State University Foundation is an institutionally affiliated nonprofit with the sole purpose of encouraging the philanthropy of individuals, corporations, and foundations toward the mission of Washington State University.

Managing an endowment of \$415 million, and nearing the milestone of its first billion-dollar comprehensive campaign, the foundation's financial resources support the University's operational, facility, and student and faculty needs.

A BILLION-DOLLAR MILESTONE

ACROSS ALL PROGRAMS, the capital campaign has invested more than half a billion dollars directly into operational support for faculty in achieving their teaching, research, and service missions. In growing the endowment, it has already created over 573 individual endowment agreements: nearly 400 in student and graduate support, 115 in ongoing operational support, 27 for faculty, and 27 for research.

A considerable investment in the current campaign has come directly from individual alumni, who account for nearly a third of the total thus far. Washington State University's mission appeals to others as well, with gifts from non-affiliated individuals, corporations, and foundations accounting for the rest.

ADVANCING THE UNIVERSITY'S MISSION

THIS PHILANTHROPY HAS ENABLED schools to form and programs to expand.

The Paul G. Allen School for Global Animal Health was created through the generosity of over \$50 million from the Bill & Melinda Gates Foundation and Paul G. Allen, among others. These gifts not only completed a state-of-the-art facility in Pullman, but also established research and outreach programs in sub-Saharan Africa, increasing the number of graduate students and research activity in the region.

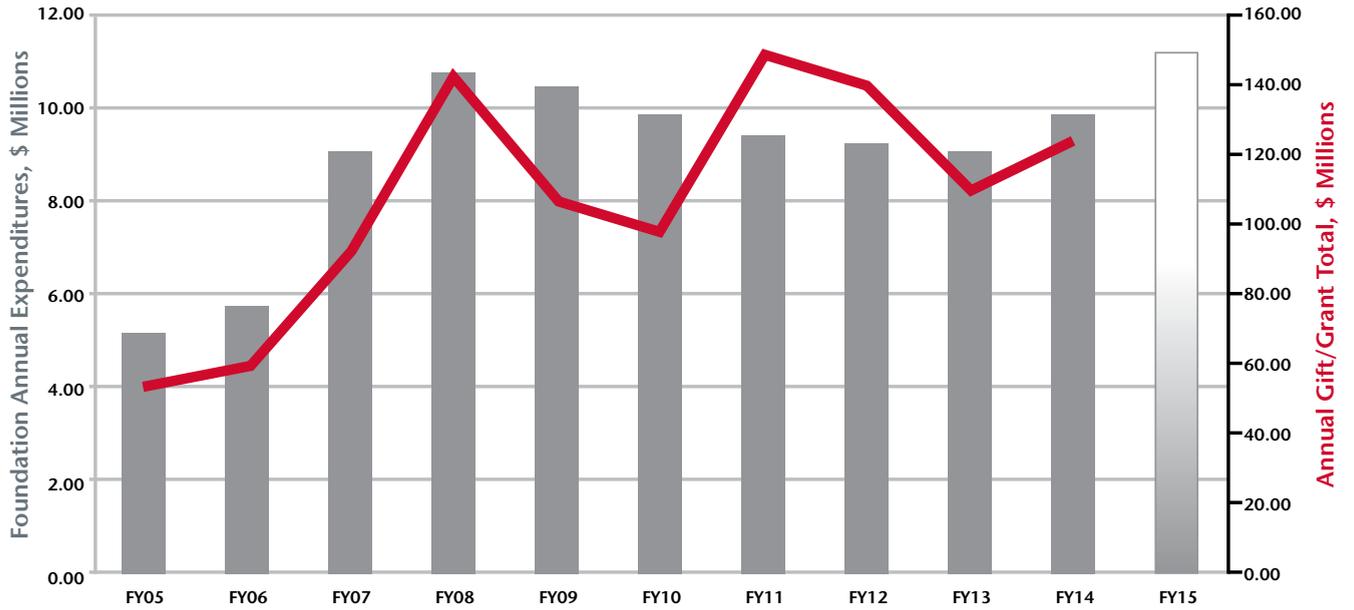
Washington's apple, pear, cherry, and stone fruit growers have joined the campaign for WSU by voluntarily taxing themselves for over \$32 million in direct financial support of Washington State University's research and extension efforts, which benefits the entire industry. The majority of these commitments are intended to establish several endowed faculty chair positions focused on research and development.

The Voiland School of Chemical Engineering and Bioengineering was created by a gift of over \$17 million by Gene and Linda Voiland. This commitment allowed the program to focus on being a research leader in catalysis by recruiting new faculty to the existing team. Already it has more than doubled the amount of federal funding from several agencies in pursuit of a sustainable energy future.

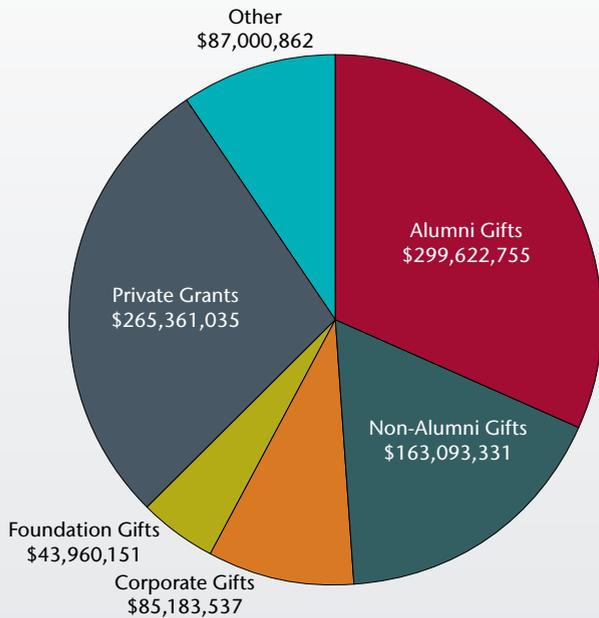
Over the past decade, the Washington State University Foundation has doubled its annual receipts of gifts, grants, and pledges from \$50 million to over \$100 million annually. With expenditures nearing \$10 million for FY2014, the Foundation's activities have returned over \$12 for every \$1 expended on behalf of Washington State University.

The completion of WSU's first billion-dollar campaign marks only the beginning of what the power of philanthropy can do for the University.

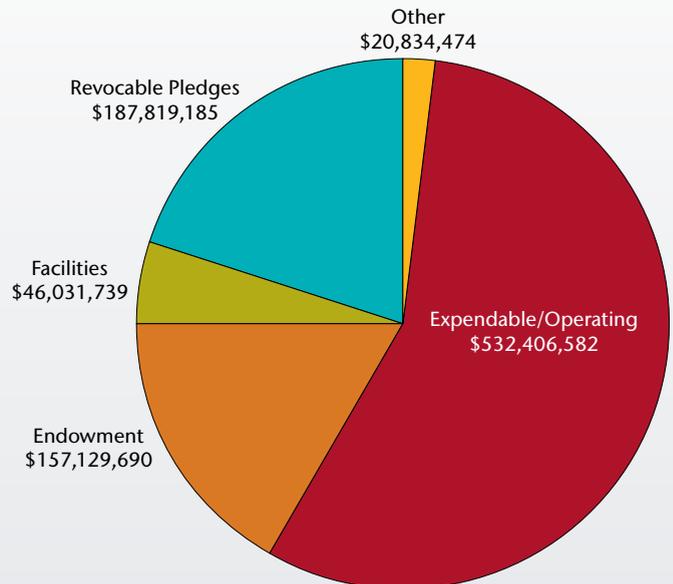
Expenditures and Gifts/Grants



Sources of Campaign Funds
as of September 30, 2014



Uses of Campaign Funds
as of September 30, 2014





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research.wsu.edu

For more information, contact
research@wsu.edu
509-335-1517